Savitribai Phule Pune University
(Formerly University of Pune)
Board of Studies, Department of Technology
Civil & Environmental (CE) Technology
Curriculum Structure for M.Tech Program

Sr. No.	Subject Code	Subject Name	Credits	Teaching Scheme (Theory)	Teaching Scheme (Lab)
Semester (I)					
1	MTC1	Mathematics for Technology	3	√	
2	CEC2	Advanced Design of Concrete Structures	3	√	
3	CEC3	Construction Management	3	√	
4	CEE1	Elective-1	3	√	
5	CEE2	Elective-2	3	√	
6	CEL1	Lab Practice - 1	3		√
7	CES1	Seminar - 1	1		√
Semester (II)					
8	CEC4	Fluid Mechanics	3	√	
9	CEC5	Design of Water & Wastewater Treatment Systems	3	√	
10	CEE3	Elective-3	3	√	
11	CEE4	Elective-4	3	√	
12	CEE5	Elective-5	3	√	
13	CEL2	Lab Practice - 2	3		√
14	CES2	Seminar - 2	1		√
Semester (III)					
15	CED1	Soft Skills / Research Methodology	3	√	
16	CED2	Elective 6 /DS(Directed Study)	3	√	
17	CEMP1	Interim Project	8		√
Semester (IV)					
18	CEMP2	Final Project (Dissertation Submission)	18		√
		TOTAL CREDITS	70		

AUDIT COURSES				
Sr. No.	**Subject Code**	**Subject Name**	**Credits**	**Semester**
1	CYSA	Cyber Security	2	I
2	HRE101	Human Rights & Duties	1	II
3	HRE102/HRE103	Human Rights & Vulnerable Groups/Law Policy , Society & Enforcement mechanism	1	III

Notes:

1) Electives can also be Open Electives in spirit of CBCS.

2) Maximum 25% Open Electives are allowed.

3) Candidates are expected to perform minimum three (3) assignments for every Lab Practice, and submit report as a bona fide document to supervisor/course instructor. The assignment may be in the form of modeling/ simulation/ programming/ experimental investigation/ fieldwork

4) The candidates are expected to select three electives from the list provided in Table(s) in this document

Savitribai Phule Pune University
Board of Studies
Civil & Environmental (CE) Technology
Curriculum Structure for Integrated M.Tech-PhD Program

Sr. No.	Subject Code	Subject Name	Credits	Teaching Scheme (Theory)	Teaching Scheme (Lab)
Semester (I)					
1	MTC1	Mathematics for Technology	3	√	
2	CEC2	Advanced Design of Concrete Structures	3	√	
3	CEC3	Construction Management	3	√	
4	CEE1	Elective-1	3	√	
5	CEE2	Elective-2	3	√	
6	CEL1	Lab Practice - 1	3		√
7	CES1	Seminar - 1	1		√
Semester (II)					
8	CEC4	Fluid Mechanics	3	√	
9	CEC5	Design of Water & Wastewater Treatment Systems	3	√	
10	CEE3	Elective-3	3	√	
11	CEE4	Elective-4	3	√	
12	CEE5	Elective-5	3	√	
13	CEL2	Lab Practice - 2	3		√
14	CES2	Seminar - 2	1		√
Semester (III)					
15	CED1	Soft Skills / Research Methodology	3	√	
16	CED2	Elective 6 /DS(Directed Study)	3	√	
17	CED3	Elective 7 /DS(Directed Study)	3	√	
17	CES3	Seminar - 3	1		√
Semester (IV)					
18	CEPR	Ph.D Pre-registration	--		√

Semester (V)					
19	CER1	Ph.D Pre-registration	--		√
Semester (VI)					
20	CER2	Ph.D Pre-registration	--		√
Semester (VII)					
21	CER3	Ph.D Pre-registration	--		√
Semester (VIII)					
22	CER4	Ph.D Pre-registration	--		√
Semester (IX)					
22	CER5	Ph.D Pre-registration	--		√
Semester (X)					
22	CER6	Ph.D Pre-registration	--		√
Semester (XI)					
22	CEFP	Ph.D viva-voce presentation	--		√

AUDIT COURSE				
Sr. No.	**Subject Code**	**Subject Name**	**Credits**	**Semester**
1	CYSA	Cyber Security	2	I
2	HRE101	Human Rights & Duties	1	II
3	HRE102/HRE103	Human Rights & Vulnerable Groups/ Human Rights & Duties in India: Law Policy , Society & Enforcement mechanism	1	III

Notes:

1) Electives can also be Open Electives in spirit of CBCS.
2) Maximum 25% Open Electives are allowed.
3) Candidates are expected to perform minimum three (3) assignments for every Lab Practice, and submit report as a bona fide document to supervisor/course instructor. The assignment may be in the form of modeling/ simulation/ programming/ experimental investigation/ fieldwork
4) The candidates are expected to select three electives from the list provided in Table(s) in this document

LIST OF ELECTIVES FOR BOARD OF CIVIL AND ENVIRONMENTAL TECHNOLOGY

Sr. No.	Stream	Subject Code	Subject Name
1	STR	CEE1	Theory of Elasticity
2	WR	CEE2	Optimization Techniques
3	CM	CEE3	TQM in Construction
4	CM	CEE4	Green construction
5	CM	CEE5	Construction Techniques and Equipments
6	CM	CEE6	Risk Analysis and Mitigation
7	ENV	CEE7	Air & Water Quality Modeling
8		CEE8	Transportation System Engineering
9	CM	CEE9	MIS in construction Industry
10	CM	CEE10	Human resource Management in construction Industry
11	CM	CEE11	Construction contracts and materials management
12	CM	CEE12	Project Economics and Financial Management
13	CM	CEE13	Construction Materials and Techniques
14	CM	CEE14	Work study and Incentive Management
15	CM	CEE15	Maintenance and rehabilitation of buildings
16	CM	CEE16	Solar Energy and Buildings
17	ENV	CEE17	Industrial Wastewater Management
18	ENV	CEE18	Sanitary Chemistry & Microbiology
19	ENV	CEE19	Energy & Environment
20	ENV	CEE20	Environmental Sanitation & Sanitation Practices for Rural India
21	ENV	CEE21	Environmental Structure Design
22	ENV	CEE22	Environmental Legislation and Management System
23	ENV	CEE23	Environmental Geotechnology

24	ENV	CEE24	Solid and Hazardous Waste Management
25	ENV	CEE25	Air Pollution and Control
26	STR	CEE26	Advanced Structural Analysis By Matrix Approach
27	STR	CEE27	Reliability Based Civil Engineering Design
28	STR	CEE28	Dynamics of Structures
29	STR	CEE29	Plastic Analysis & Design of Steel Frames
30	STR	CEE30	Finite Element Method
31	STR	CEE31	Soil-Structure Interaction
32	STR	CEE32	Theory of Plates and Shells
33	STR	CEE33	Advanced Design of Steel Structures
34	STR	CEE34	Advanced Foundation Design
35	STR	CEE35	Earthquake Resistant Design of Structures
36	STR	CEE36	Design of Precast Components and Ferrocrete
37	WR	CEE37	Dam Engineering
38	WR	CEE38	Wave Mechanics
39	WR	CEE39	Planning & Management of Water resources
40	WR	CEE40	Open channel flow
41	WR	CEE41	Irrigation and Drainage
42	WR	CEE42	Sediment Transport & River Mechanics
43	WR	CEE43	Ground water modeling
44	WR	CEE44	Hydrology
45	WR	CEE45	Remote sensing and GIS in wRE
46		CEE46	Project Monitoring and Control
47		CEE47	Engineering contract Administration

48		CEE48	Sustainable Materials
49		CEE49	Concrete Technology
50		CEE50	Transport infrastructure planning, development and evaluation
51		CEE51	Sanitary chemistry and microbiology
52		CEE52	TQM and MIS in civil engg.
53		CEE53	Advanced Hydrology
54		CEE54	Public Transport Management
55		CEE55	Valuation
56		CEE56	Pavement Distress
57		CEE57	Advanced Statistics
58		CEE58	Advanced Waste Water Treatment
59		CEE59	Introduction to Enzymes and Fermentation Technology
60		CEE60	Intellectual Property Rights
61		CEDS1	Advanced Earthquake Resistant Design of Structures
62		CEDS52	Adv. TQM in Construction

MATHEMATICS FOR TECHNOLOGY (COMPUTATIONAL METHODS)

Unit 1: Numerical differentiation I:

Partial differential equation Laplace and Poisson's equation-solution, method of characteristics for solution of initial boundary value problems, relaxation method

Unit 2: Numerical differentiation II:

Finite Difference, Gaussian elimination and Gauss, Jordan methods, matrix inversion, Gauss Seidel method –Newton- Raphson method

Unit 3: Statistics and Probability:

Moments, Skewness and Kurtosis, Probability, conditional probability, various theoretical distributions like binomial, normal, log-normal, Poisson, gamma distribution, Pearson type I, II & II distribution test of significance, Gumbel distribution, testing of hypotheses – Large sample tests for mean and proportion, Chi-square test, errors, types of errors.

Unit 4: Regression and Correlation:

Regression and correlation – rank correlation – multiple and partial correlation – analysis of variance-one way and two way classifications – experimental design – Latin square design

Unit 5: Transforms:

Laplace Transformer: LT of standard function, inversions and their application in civil engg. Fourier Transformer: Fourier integral, Fourier transform and their application in civil engg.

Unit 6: Matrix method and Finite element:

Matrix method analysis (Stiffness) co ordinate calculation for different types of structure. Finite element method basics (1D and 2D) co ordinate calculations.

Reference Books

1. Higher Engineering Mathematics by B. S. Grewal (Khanna Publication, Delhi).
2. Venkatraman, M.K., Numerical Methods in Science and Engineering, National Publisher Company.
3. Numerical Methods by Krishna Raju
4. Shanthakumar M.S., Numerical Methods & Analysis
5. Gupta, S.C. and Kapur, V.K., "Fundamentals of Mathematical Statistics ", Sultan Chand & Sons, New Delhi, 1999.

S.P.Pune University

Department of Technology

SYLLABUS FOR MTech- Integrated MTech-PhD (Civil and Environmental Technology)

ADVANCED DESIGN OF CONCRETE STRUCTURES

Unit 1: Design Loads and combinations:

Calculations of design dead load, live load, wind load, snow load and loading combinations in accordance with the relevant Indian codes of practice (IS: 875-1987 (5 parts)). Seismic loadings, Loads resulting from uneven settlement, Blast load, Dash load/Collision of vehicle, Fire load, load due to soil pressure etc.

Introduction to Liquid induced loads for operational, for testing, internal pressure loads, thermally induced loads, Insulation loads etc.

Unit 2: Analysis of RCC Slabs:

Yield line theory for analysis of slabs, Various patterns of yield lines, Assumptions in yield line theory, Equilibrium and virtual work method of analysis, Design of various slabs such as rectangular, triangular, circular with various edge conditions , Design for limit state of strength and serviceability orthotropically reinforced slabs,

Unit 3: Liquid Retaining Structures (Over Ground):

Basic design philosophy. Analysis and design of single cell rectangular water tanks subjected to hydrostatic loading based on plate theory.

Design of overhead water tanks, Intz tanks

Unit 4: Liquid Retaining Structures (Under Ground):

Design of Under Ground Water Tank with Counterforte Retaining Wall, subjected to Surcharge, Basic design philosophy. Calculation of lateral earth pressure based on Rankine's theory. Analysis and design of RC gravity walls, cantilever walls.

Unit 5: Foundation Design:

Design of foundation system and Geotechnical design for Hydraulic Failure such as failure by uplift (buoyancy), failure by heave; failure by internal erosion; failure by piping.

Design of Raft and Pile foundation.

Unit 6: Ductile Detailing of RCC Structures:

Ductile detailing as per IS: 13920. 7

Reference Books

1. Pillai S U and Menon Devdas, Reinforced Concrete Design, TATA Mc-Graw hill publishing co. Ltd., New Delhi

2. B.C. Punmia, Ashok K. Jain, Arun K. Jain – Reinforced Concrete Structures Vol. II, Laxmi Publications, New Delhi

3. N.C. Sinha, S.K. Roy – Fundamentals of Reinforced Concrete, S. Chand & Co. Ltd, New Delhi

4. P.C. Varghese – Advanced Reinforced Concrete Design, Prentice Hall of India Pvt. Ltd., New Delhi

5. H.J. Shah– Reinforced Concrete, Vol I & II - Charotar Publishing House

6. Joseph E. Bowels – Foundation Analysis and Design-, TATA Mc-Grawhill

7. Nainan P Kurian – Design of Foundation Systems, Narosa publication house

8. M.J.Tamlinson – Foundation Design & Construction, ELBS publication

9. G. A. Leonards, Foundation Engineering, McGraw-Hill, 1962.

10. J.E. Bowles, Foundations Analysis and Design, 3rd Ed., McGraw-Hill, 1968.

11. R.B. Peck, W.E. Hanson and T.H. Thornburn, Foundation Engineering, 2nd

12. Fang , H.Y.,(1991),” Foundation Engineering Handbook”, Chapman & Hall,NY.

13. Teng .W.C.(1962), Foundation Design , Prentice Hall International.

14. IS: 456: Indian Standard code of practice for plain and reinforced concrete, Bureau of Indian Standards, New Delhi

15. IS: 3370-Indian Standard code of practice for concrete structures for storage of liquids, Bureau of Indian Standards, New Delhi

16. IS:13920 – Ductile Detailing of Reinforced Concrete Structures Subjected to Seismic Force, 1993

17. IS: 1904-1986, “Code of Practice for Design and Construction of Foundations in Soils, general Requirements”.

18. IS: 2911-1979, “Code of Practice for Design and Construction of Pile Foundation”

S.P. Pune University

M. Tech. (Civil and Environmental Technology)
SEMESTER - I

CONSTRUCTION MANAGEMENT

Unit 1: Introduction:

Traditional management and modern scientific management, Principles of management, Theories of Taylor, Fayol, Mayo, McGregor, Weber, Gilbreth. Project Management -Basic forms of organization. Construction scope, project management phases & processes, construction project Management practice, construction project manager's role & skills, major causes of project failure.

Unit 2: Construction Planning and Scheduling:

Construction Management & General Contracting , Project work breakdown levels, development methodology, WBS, Defining project activities & estimating activity durations. Scheduling – Bar chart, network scheduling, linear scheduling, and precedence network analyses with examples.

Unit 3: Resource management and Cost control:

Resource allocation, leveling, constraining, updating, earned value. Compression of network & Project cost.

Unit 4: Construction Equipments:

Construction Equipments – Understanding basics and functions of Equipment Earthmoving Machinery, Concreting Equipment, Material Handling Equipment and Transportation of Equipments.

Unit 5: Equipment Management:

Equipment Management, Costing, Optimum utilization and Equipment selection, depreciation, interest on capital, Manpower, Spare parts etc, Documentation, Log-Books, History Books.

Unit 6: Construction safety:

Accidents, types, primary accidents to be taken, legal formalities, safety policy, equipment safety.

Lab:

One assignment on each unit with special emphasis on use of software like MSP, Primavera etc., wherever required. 9

Reference Books

1. Construction Project Management: Planning, Scheduling and Control by Chitkara, K.K., Tata McGraw-Hill Publishing Company, New Delhi, 1998

2. Project Planning, Scheduling and Control in Construction by Calin M. Popescu, Chotchai Charoenngam, An Encyclopedia of terms and Applications, Wiley, New York, 1995.

3. Project Management for Construction, Fundamental Concepts for Owners, Engineers, Architects and Builders by Chris Hendrickson and Tung Au, Prentice Hall, Pittsburgh, 2000.

4. Scheduling Construction Projects by Willis, E. M. John, Wiley & Sons, 1986

5. Financial and Cost Concepts for Construction Management by Halpin, D. W., John Wiley & Sons, New York, 1985.

6. Work study – Currie.

7. Roy, Pilcher Construction Management Construction Planning, Equipment and Methods by Peurifoy, R.L., Ledbetter, W.B. and Schexnayder, C., McGraw Hill, Singapore, 2006.

8. Construction Equipment and Management by Sharma S.C., Khanna Publishers, New Delhi, 1988.

9. Construction Equipment and Job Planning by Deodhar, S.V., Khanna Publishers, New Delhi, 1988.

S.P. Pune University

M. Tech. (Civil and Environmental Technology)
SEMESTER - II

FLUID MECHANICS

Unit 1: Introduction:

Revision of concepts in basic Fluid Mechanics such as classification of flows, Equation of continuity for three dimensional flow in Cartesian co-ordinates, equation of continuity for one-dimensional flow along a streamline, types of motion, rotational and irrotational motion, velocity potential, stream function and flow net, Euler's equation of motion along a streamline and its integration, Bernoulli's equation. Development of boundary layer on a flat plate nominal, displacement, momentum, energy thicknesses, laminar, transitional and turbulent boundary layer, laminar sub layer, Local and mean drag coefficients

Unit 2: Kinematics:

Continuity Equation in polar and cylindrical coordinates, conformal mapping, Standard two dimensional flow pattern, source, sink, doublet

Unit 3: Laminar Flow:

Navier strokes equation-derivation, flow between parallel plates-it's exact solution, Laminar flow through a circular pipe

Unit 4: Boundary Layer Theory:

Karman's momentum integral equation, Karman Pohelhausen's solution, boundary layer separation

Unit 5: Turbulent Flow:

Characteristics of turbulent flow, instantaneous velocity, temporal mean velocity, scale of turbulence and intensity of turbulence, prandtl's mixing length theory, velocity distribution in turbulent flow-prandtl's velocity distribution equation. Reynolds' equation of motion, typical solution, Energy and Momentum equation, Statistical theory of turbulence

Unit 6: Fundamentals of Compressible Flow:

Compressible fluid flow-fundamental equation, continuity equation, energy equation, velocity of propagation, Pressure, density and temperature in terms of Mach number,

Normal shock in one dimensional compressible flow and compressible flow around immersed bodies

Reference Books

1. Fluid Mechanics and Hydraulic Machines – Sukumar Patil, Tata McGraw-Hill

2. Fluid Mechanics- Grade & Mirajgaonkar

3. Fluid Mechanics and Machinery- D. Ramadurgaiah, New age International

4. Boundary Layer Theory- H. Schlichting, Springer New-York 2000

5. Fluid Mechanics-Victor L Streeter & E.B. Wylie, Mc-Graw Hill

6. Fluid Mechanics-Frank M White, Mc-Graw Hill

7. Fluid Mechanics-Fundamentals and Applications- Cengel and Cimbala, McGraw-Hill 12

S.P. Pune University

M. Tech. (Civil and Environmental Technology)
SEMESTER - II

DESIGN OF WATER & WASTEWATER TREATMENT SYSTEMS

Unit I:

Estimation of water demand based on population projection. Designs of source intakes, raw water pumping main, economic design of rising main, determination of storage capacity of reservoirs.

Unit II:

Raw Water Characteristics, Flow charts for WTPS wrt various sources, Theory & Design of Aeration System – Cascade Aerator; Theory & Design of Plain ST & Clari-flocculator; Tube Settlers.

Unit III:

Filteration: Theory & Design; Disinfection: Theory & design

Unit IV:

Sewage generation, Collection and Transmission: Theory & Design; . Wastewater Characteristics; Theory & design of primary units: Screen Chamber, Grist Chamber. PST

Unit V:

Principles & design of Biological Treatment Units: ASP, TF, OP, MAL;

Unit VI:

Theory of UASB; On-site sanitation for rural areas: two pit latrines; ST followed by leach pit / soak pit / dispersion trenches.

Reference Books

1. Weber, W.J., Physicochemical processes for water quality control, John Wiley and sons, Newyork, 1983.

2. Peavy, H.S., Rowe, D.R. and Tchobanoglous, G. Environmental Engineering, McGrawHills, New York 1985.

3. Metcalf and Eddy, Wastewater Engineering, Treatment and Reuse, Tata McGraw-Hill Publication, New Delhi, 2003

4. Water & Waste Water Engineering by Fair and Gayer. C.A. Sastry, Water TreatmentPlants, Narosa Publishing House, Bombay, 1996.

5. CPHEEO Manuals on Water Treatment and Sewerage & Sewage Treament – MoEF, GoI, New Delhi

M.Tech. (Civil and Environmental Engineering)

SEMESTER I

Elective 1

Dam Engineering

Module 1

Reservoir Planning

Types, developments, Storage and diversion works, Purpose: Single and multipurpose,

Investigation for locating a reservoir, Selection of site, estimation of required storage, mass curves, reservoir losses, reservoir operation, economics of reservoir planning, benefit cost ratio, price escalation of projects

Module2

Dams

Introduction, Classification of dams based on function, hydraulic design, materials of construction, Choice of type of dam, selection of dam site, site investigations, sunsurface explorations

Module3

Gravity Dams:

Forces acting on the gravity dams earthquake force-pseudostatics and dynamic response approach, load classifications, stability analysis, distribution of shear and normal stresses, principle stresses, Stress concentration around openings, foundation treatments, Design of concrete dam.

Module 4

Earthen Dams:

Seepage through dam and its foundations, stability analysis for sudden drawdown condition, steady seepage condition, end of constructions, seismic effects, pore pressures, protection of upstream and downstream slopes.

Module 5

Arch Dams

Arch dams-General concepts of trail load theory, elastic shell methods, thick cylinder theory

Buttress Dam and Rock fill Dams:

Relevant rock fill characteristics, general design principal method of construction and compaction.

Buttress dam- Concepts and Design

Module 6

Spillways-

Spillway-types, components, design principles, Design of different spillways such as Ogee, side channel, siphon. Energy dissipation devices and their design

Reference Books

1. Concrete Dams – R.S. Varshney

2. Irrigation Water Resources & Water Power Engineering P.N. Modi

3. Earth Dams – J.L. Sherard

4. Water resources Engineering Principles and Practice- S. Murty Challa- New Age International

5. Elements of water resources engineering – K.N.Duggal, J.P.Soni, New Age International

Elective I

Mechanics of Waves

Module 1

Introduction, Generation, Decay, Classification, Measurement, Wave Forecasting: The Significant Wave, Simplified versus Elaborate Technique, Simplified Methods- SMB method, Hasselmann method, Darbyshire and Draper's Technique, Forecasting in Hurricanes, Numerical Wave Modeling (introduction only, no mathematical treatment): Phase resolving models, Phase averaging models

Module 2: Wave Theories

Basic hydrodynamic equations, wave theories - Linear wave theory, Finite amplitude wave theories (introduction only, no mathematical treatment): Stokes, wave theory, Cnoidal wave theory, Solitary wave theory, Dean stream function theory, Trochoidal wave theory, Non-linear versus linear wave theory, Choice of wave theory

Module 3: Random waves

Wave spectrum analysis, wave spectra and statistics, Theoretical spectra: Pierson-Muskowitz Spectrum, Bretschneider Spectrum, JONSWAP Spectrum, Scott Spectrum, Scott-Wiegel Spectrum

Wave statistics: Short term wave statistics, Tucker method, Long term wave statistics- Gumbel distribution, Weibull Distribution, Log Normal Distribution, Fretchet Distribution, Upper bound Type III u distribution,

Long Term Distribution of Individual Wave Heights

Module 4: Wave propagation

Wave shoaling, wave refraction, wave diffraction, wave reflection, combined effects using numerical solutions, wave breaking, wave set up and set down, wave runup

Module 5: Wave Forces On Shore-Based Structures

Forces on Vertical Faced Structures: Non- breaking wave forces, breaking wave forces, forces by broken waves, forces on Seaward structures, forces on landward structures, oblique wave attack. Forces on sloping face structures: Single rubble mound, composite breakwater

Module 6: Wave Force On Small Diameter Members

The Morison's equation, Total Wave Force On The Entire Member Length, Wave Forces Using Stokes (V) Theory, Calculation Of Wave Forces Using Dean's Theory, Wave Force On Inclined Members (introduction only-rigorous mathematical treatment to be avoided), Wave Slam, Limitations of the Morrison's Equation

Books:

Sarpkaya, T., Issacson, M. (1981). "Mechanics of Wave Induced Forces on Offshore Structures",Van Nostrand Reinhold.

U.S. Army Corps of Engineers. (2002). "Coastal Engineering Manual", U.S. Army Corps of Engineers, Washington, D.C.

WMO. (1988). "Guide to Wave Analysis and Forecasting", Pub. NO. 702, World Meteorological Organization, Secretariat of WMO, Geneva.

Dean, R. G., Darlymple R. A. (1991). "Water Wave mechanics for Engineers and Scientists", World Scientific

Sorensen, R. M. (1997). "Basic Coastal Engineering", Springer

Elective I

Remote sensing and GIS in WRE

Module 1 Concept of remote sensing:

Electromagnetic energy, Interaction of EMR with Atmosphere and earth material, atmospheric windows, EMR spectrum, platform, sensor types, MSS. Aerial Remote Sensing:- Flight planning, types of Aerial photographs,. Photogrammetry: stereoscopic vision, scale, relief displacement, parallax, vertical exaggeration.

Module 2 Satellite Remote Sensing:

LANDSAT and IRS characteristics, products and FCC, Interpretation Techniques, visual and digital in brief, Recognition of photo elements and terrain elements like size, shape, tone, texture, pattern, shadow etc, Terrain analysis: Relief, landform, drainage pattern

Module 3

Use of remote sensing in Lithology, structure and Geomorphology Application of Remote Sensing in Ground Water and Mineral Exploration, Basic Concept of GIS, components, history and applications, Hardware and Software requirements for GIS, Map features, Scale, Resolution, accuracy and data base extent

Module 4 Map projection and parameters:

Geographical Coordinate system, types of projection and parameters, projection transformation and mapping in GIS. Geospatial data models: Spatial and non-spatial data, VECTOR and RASTER models.

GIS Analysis: Digitalization, editing and structuring of map data, overlay analysis, Digital elevation and terrain model (DEM / DTM), buffer analysis and query analysis, Introduction to GPS and their applications with limitations, Applications of GIS in Environmental Engineering

Reference Books

1. Remote sensing methods & applications – R. Michael Hord, Wily Interscience Publication.

2. Remote sensing & image interpretation – Lilleson J.T.M. & Krefer R.W. Wiely, New York.

3. Photogrammetry by – Sheford

4. Remote sensing in Civil Engineering – J.M. Kennie & M.C. Mathews.

Elective II

Planning and Management of Water Resources

Module 1

Introduction:

Objectives: of water resource planning and management, its Necessity, Aspects of water resources planning, water resource development; needs and opportunities; social goals.

Module 2

constraints in the development of planning and management of water resources like non reversibility; planning region and horizon. Demand for drinking water; irrigation, hydropower; navigational; planning for flood control.

Module 3

Reservoir operation studies - Characteristics and functions of reservoir; reservoir sedimentation; conservation storage; conflict among uses. Effect on river regime; long term simulation; reliability; resiliency and vulnerability assessment

Module 4

Management of Ground-Water Resources: Ground water evaluation; conjunctive use of surface and ground water. Basin planning; inter-basin transfer of water.

Module 5

Cost benefit studies of single and multipurpose projects– multi objective

planning models, financial analysis of water resources projects.

Module 6

Economic Planning: Allocation of cost of multipurpose projects; repayment of cost.Discounting techniques; benefit cost parameters; estimation of benefits and costs; appraisal criteria; social benefit cost analysis.

Reference Books

1. James, L .D., and Lee, R. R., “Economics of Water Resources Planning”, Mc Graw Hill.

2. Principles of Water Resources planning-by Goodman.

3. Water Resources System Planning – by M.C. Chaturvedi.

4. Water Resources Planning and Management by-O.J. Helwege.

5. Water Management System Application-A.K. Biswas

6. Water resource Engineering- Linsley and Franzini, Mc Graw-Hill

7. Water resources planning and management- Grafton and Hussey, Cambridge Uni. Press.

Elective II

Optimization Techniques

Unit 1

System Concepts: System concepts, definitions, needs for system approach, different types of system parameters and variables.

Unit 2

Linear Programming: Revision, Big M Method, duality, sensitivity analysis. Application of Linear Programming for Hydraulics & Water Resource

Unit 3

Non Linear Programming: Unconstrained one Dimensional search methods, Dichotomous search method, Fibonacci, Golden section, multivariable unconstrained, gradient techniques, steepest ascent and descent methods, Newton's methods, Application of Dichotomous search method, Fibonacci & Golden section to the various sectors of Water Resource Engineering, constrained Lagrangian multiplier techniques

Unit 4

Dynamic Programming: Principle of optimality, recursive equations. Application of Dynamic programming to Water Resource Engineering

Unit 5

Stochastic Methods: Queuing theory, simulation technique, sequencing model, Morkov's process

Unit 6 Theory of games, 2 person zero sum game with and without saddle point, mixed strategies (2 x n games or m x 2 games), 2 x 3 game with no dominance, graphical method

Reference Books

1. Engineering Optimazation Theory & Practice – S.S. Rao., Wiely.

2. Operation Research – Taha Hamdey A.

3. Principles of Operation Research – Wagner, Prentice Hall.

4. Operation Research – Hira and Gupta, S.Chand

Elective III

Open Channel Flow

Module 1

Uniform flow-Review and revision of uniform flow formulae and design of channels, Depth-energy relationship, specific energy, specific force, Critical flow, critical flow computations

Module 2

Gradually Varied Steady Flow:

Gradually varied steady flow and rapidly varied steady flow in open channels, surface profiles in GVF analysis, Different method of computations, Chow's methods, standard step method, and finite difference method

Module 3

Rapidly varied flow--Hydraulic Jump:

Formations of jump in expanding and contracting channel, jump type, jump control, jump on sloping floors,

Module 4

Spatially Varied Flow:

Differential Equation of spatially varied flow, profile computation, SVF with lateral inflow.SVF with lateral outflow

Module 5

Unsteady Flow:

Gradually varied unsteady flow: Continuity equation, dynamic equation, Monoclinal rising waves,dynamic equation for uniformly progressive flow, wave profile of uniformly progressive flow, wave propagation, Rapidly varied unsteady flow: Uniformly progressive flow, positive surge, negative surge, dam break problem

Module 6

Flood Routing:

Hydraulic and Hydrologic flood routing, Reservoir and channel routing, Differential form of

Momentum Equation, Muskinghum method, Finite difference scheme, Method of characteristics.

Reference Books

1. Open Channel Hydraulics – Ven Te Chow, Mc-Graw Hill.

2. Flow through Open Channel-K.G.Ranga Raju, Tata Mc-Graw Hill.

3. Flow in Open Channel – K. Subramanya, Tata Mc-Graw Hill.

4.Flow through open channels—Rajesh Srivastava—Oxford University Press

5. Open Channel Hydraulics-French, Mc-Graw Hill.

Elective III

Irrigation and Drainage

Module 1

Soil water Relationships

Water storage zones and relative equilibrium states, flow of water in saturated and unsaturated soil, soil moisture determination

Module 2

Water-Soil Plant Relationships

Evaporation, transpiration, consumptive use, Salinity and Alkalinity in irrigated soil, Soil Erosion and conservation

Module 3

Drip Irrigation

General concept, advantages, disadvantages, elements, design concepts

Module 4

Lift Irrigation :

General concept, elements of lift irrigation schemes, design consideration involved in intake well, jackwell, rising main, distribution system, concept of cost economics.

Module 5

Sprinkler Irrigation

General concept, advantage and disadvantages, components of the system, types of

Sprinklers, design concept

Module 6

Drainage of Irrigated Land

Need and purpose of drainage, water logging, design and construction of drainage

systems, Ministry of agriculture- WMD recommendations.

Reference Books

1. Irrigation, Water Resources & Water Power Engineering, P.N. Modi

2. Irrigation Engineering Theory & Design – R.S. Varsheny.

Elective IV

Sediment Transport & River Mechanics

Module 1

Introduction

Introduction fluvial hydraulics, Definition of sediment, Origin and formation of sediments, Nature of sediment problems, fundamental properties of individual sedimentary particles, Concept of fall velocity, Bulk properties of sediment

Module 2

Incipient Motion

Approaches of establishment of incipient motion, Shields analysis, Regimes of flow – study of different bed forms like ripples, dunes, anti - dunes with characteristics, significances, resistance analysis

Module 3

Sediment Transport

Modes of sediment transport, Introduction to different bed load equations – empirical, dimensional and semi-theoretical equations. Detailed study of DuBoy's equation, Enstein equation, Meyer-Peter and Müller equation. Concept of suspended load, total load, wash load.

Module 4

Stable Channel Design

Concept of stable channel, Design procedures such as Kennedy method, Lacey's method. Brief introduction of other methods such as Bunch, Simmon- Albertston method, Tractive force approach

Module 5

Sediment Measurements

Measurement of bed load and suspended load , Plan forms of river bends, Channel characteristics, bifurcations, confluences, river gauging, continuity Equation for sediment, stream bed changes during Floods, Silting of reservoir

Module 6

River Training Works

Objective of river training and bank protection, River training for flood control, navigation, Guiding the flow, sediment control, River bank protection, Introduction to sediment transport through pipes, Introduction to alluvial river models

Reference Books

1 Yang. C.T. "Sediment Transport theory and Practice " McGraw –Hill , New-York, 1996

2. Graf, W.H. "Hydraulics of Sediment Transport", McGraw –Hill , New-York,1971

3. Raudkivi, A.J. "loose Boundary Hydraulics"2nd edition, Pergamon Press, 1976

4. F.M.Hendorson," Open Channel Flow "Mac Millon , New York , 1996

5. Grade, R.J. and Ranga Raju, K.G."Mechanics of Sediment Transport and Alluvial Stream

Problems" New Age International (P) Ltd. Publications, New Delhi , 2006.

Elective IV

Hydrology

Module 1

Introduction:

Hydrologic Cycle, Precipitation, Evaporation, Infiltration, Interception and Depression, Depth area duration analysis, Unit hydrograph theory, IUH. Stochastic processes-classification, time series & it's components

Module 2

Flow Generation

Various statistical distributions like binomial, normal, log-normal, Poisson, Beta B, gamma, Pearson type I, II and III & their uses in hydrology, Chi square test, plotting, position, frequency factors, extreme value theory, synthetic generation of yearly and monthly flows in hydrology.

Module 3

Frequency analysis of hydrologic events

Frequency analysis, Frequency distribution models Flood estimation by various methods, forecasting of floods, flood frequency analysis, Gumbel's, Pearson type I, II, and III distribution, Log-normal method, design flood for various hydraulic structures and flood routing.

Module 4

Groundwater Hydraulics and its Development:

Introduction of Ground Water Hydraulics, aquifers, vertical distribution of subsurface water, Darcy's Law-it's range of validity, Dupuit's assumption, application of Darcy's law to simple flow systems governing differential equation for confined and unconfined aquifers.

Module 5

Well hydraulics:

Definition of wells, types of wells, differential equation for fully & partially penetrating wells, interference of wells, pumping test with steady & unsteady flow, method of image. Well Exploration, well construction & design, screens, perforations & gravel Packs.

Module 6

Groundwater Conservation and modeling techniques

Ground water budget, seepage from surface water artificial recharge, Porous media models, Analog models, Electric analog models, Digital computer models and their applications

Reference Books

1. Applied Hydrology-Linsley Kolhar & Paulhas (Mc-Graw Hill)

2. Water Resource & Hydrology-S.K. Garg.

3. Engineering Hydrology-K. Subramanya, Tata Mc-Graw Hill.

4. Elementry Engineering Hydrology—M.J.Deodhar--- Pierson Edution

4. Hydrology- H.M. Raghunath, Wily Eastern, New Delhi.

5. Stochastic Hydrology-Jaya Rami Reddy, Laxmi Pub., New Delhi.

6. Applied Hydrology-V.T. Chow, McGraw-Hill Book Company.

7. A text book of Hydrology- Jaya Rami Reddy, University Science Press

8.Ground water Hydrology---D.V.Todd---Wieley,India.

9 Numerical Groundwater Hydrology-----A.K.Rastogy.---Penram Internal Publishing(India).

Elective IV

Ground Water Modeling

Unit 1

Groundwater Occurrence & Movement: General Introduction, Darcy's law, application of Darcy's law to confined and unconfined aquifers, wells - fully & partially penetrating wells, multiple wells, interference of wells, pumping test with steady and unsteady flow

Unit 2

Surface and sub-surface investigation of ground water: Geological/geophysical exploration/remote sensing/electric resistivity/seismic refraction based methods for surface investigation of ground water, test drilling and ground water level measurement

Sub-surface ground water investigation through geophysical/resistivity/ spontaneous potential/radiation/temperature/caliper/fluid conductivity/fluid velocity/miscellaneous logging

Unit 3

Planning of groundwater development: Water balance, assessment of recharge, utilizable recharge, Groundwater estimation norms in India, Constraints on groundwater development, Planning of ground water development in canal command areas-conjunctive use models, planning of ground water development in coastal aquifers

Unit 4

Numerical modeling of groundwater flow: Ground water modeling through porous media/analog/electric analog/digital computer models; Review of differential equations, finite difference solution, direct problem, inverse problem; groundwater modeling using finite element method

Artificial ground water recharge: Concept, methods of artificial ground water recharge, waste water recharge for reuse, water spreading

Unit 5

Management of Ground Water: Ground water basin management concept, hydrologic equilibrium equation, ground water basin investigations, data collection & field work, dynamic equilibrium in natural aquifers, management potential & safe yield of aquifer, stream-aquifer interaction

Unit 6

Saline water intrusion in coastal aquifers: Ghyben-Herzberg relation between fresh & saline waters, shape & structure of fresh & saline water interface

Upcoming of saline water, fresh-saline water relations on oceanic islands, sea water intrusion in Karst terrains, saline water intrusion control

Reference Books

1. Remson, I., Hornberger, G.M., and Molz. F.J., Numerical methods in sub-surface hydrology, Wiley Inter Science.

2. Rushton, K.R. and Redshaw, S.C., Numerical analysis by analog & digital methods, John Wiley.

3. Todd, D.K., Groundwater Hydrology, John Wiley, 1980.

4. Groundwater Modeling by Anderson.

5. Numerical ground water modeling by A K Rastogi, Penram International Publishing (India) Pvt Ltd. 2007